

tion of the district on the morning of the 13th for which warnings were issued on the morning of the 12th.

The Daily States of September 13, 1902, commenting on the forecasts and warnings, says:

The frost predicted for the northwestern portion of the cotton belt came just as expected. The gratifying feature is that no important weather changes take place without timely warning of their coming being given by the Weather Bureau, and the confidence which the people show in these warnings is not misplaced.

I. M. Cline, Forecast Official.

CHICAGO FORECAST DISTRICT.

A larger number of storms than usual for the season crossed the upper lakes. The storms, while not unusually severe, had greater intensity than is generally experienced in September. Warnings were issued well in advance of the gales, and no casualties of consequence have been reported. The first marked frost condition moved from the extreme northwest over the upper Mississippi Valley and the upper Lake region from the 3d to the 5th. On the 12th and 13th frost occurred practically throughout the entire district, freezing temperatures occurred in the western portion of the district, and the frost was heavy as far east as the Ohio Valley. Frost of less consequence occurred at other times during the first and second decades of the month. Warnings were issued well in advance of the frosts.—*H. J. Cox, Professor.*

DENVER FORECAST DISTRICT.

Timely warnings were issued for the first severe frost of the season which occurred in Wyoming and eastern Colorado on the morning of the 12th; also for the heavy frost of the 27th in Utah and the lower Arkansas Valley. Notices of light frost were included in the forecasts.—*F. H. Brandenburg, Forecast Official.*

SAN FRANCISCO FORECAST DISTRICT.

The month as a whole was an unusually quiet one. Dense smoke prevailed from about the middle of the month for a period of a week or more. The smoke was due to extensive forest fires in the northern Pacific coast States.—*A. G. McAdie, Professor.*

PORTLAND, OREG., FORECAST DISTRICT.

The only special feature of the month was a storm which swept across the district on the 26th, in connection with which shipping interests were given ample warnings. Sharp frosts occurred frequently during the latter portion of the month, and as a rule they were accurately forecast.—*E. A. Beals, Forecast Official.*

RIVERS AND FLOODS.

The rivers, as a rule, conformed to the usual periodical custom, and fell steadily during the month except along the eastern slope of the Appalachians, where heavy rains about the end of the first decade caused a general though not particularly marked rise. Still heavier and more general rains dur-

ing the last few days of the month caused another rise which was much more pronounced along the Susquehanna River, but not so much so as farther south.

In the upper Mississippi and the Ohio rivers the low stages seriously interfered with navigation. The last through boat for St. Louis left St. Paul on the 24th, while on the Ohio navigation was practically suspended north of Cincinnati, only a few local boats remaining on the river. Navigation on the upper Tennessee was also suspended until the heavy rains of the last week of the month afforded some relief.

The highest and lowest water, mean stage, and monthly range at 143 river stations are given in Table VII. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are: Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Forecast Official.*

AREAS OF HIGH AND LOW PRESSURE.

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocity.	
	Date.*	Lat. N.	Long. W.	Date.	Lat. N.	Long. W.	Length.	Duration.	Daily.	Hourly.
High areas.										
I.....	1, a. m.	41	101	4, a. m.	46	60	Miles. 2,250	Days. 4.0	562	Miles. 23.4
II.....	2, a. m.	52	122	6, p. m.	46	60	3,600	4.5	800	33.3
III.....	5, p. m.	47	123	9, a. m.	46	60	3,550	3.5	1,014	42.3
IV.....	8, a. m.	49	124	12, p. m.	46	60	3,800	4.5	844	35.2
V.....	10, a. m.	51	120	17, p. m.	46	60	3,800	7.5	507	21.1
VI.....	16, a. m.	51	114	19, a. m.	47	84	1,800	3.0	600	25.0
VII.....	20, p. m.	47	123	21, p. m.	47	97	1,250	1.0	1,250	52.1
VIII.....	22, p. m.	51	104	26, a. m.	45	67	2,000	3.5	571	23.8
IX.....	28, p. m.	47	123	30, a. m.	34	102	1,400	1.5	933	38.9
Sums.....							23,450	33.0	7,081	295.1
Mean of 9 paths.....							2,606		787	32.8
Mean of 33.0 days.....									711	29.6
Low areas.										
I.....	1, a. m.	54	114	5, a. m.	48	60	3,000	4.0	750	31.2
II.....	3, p. m.	51	120	6, p. m.	48	84	1,700	3.0	567	23.6
III.....	6, p. m.	51	114	10, a. m.	48	68	2,250	3.5	643	26.8
IV.....	10, p. m.	35	106	14, a. m.	47	65	2,975	3.5	850	35.4
	12, a. m.	36	87				1,600	2.0	800	33.3
V.....	15, a. m.	50	110	17, p. m.	46	87	1,150	2.5	460	19.2
	18, a. m.	51	120	18, p. m.	29	89	2,200	3.5	629	26.2
VI.....	18, a. m.	39	120	24, p. m.	38	90	3,300	6.5	508	21.2
VII.....	24, p. m.	51	114	29, a. m.	42	71	3,250	6.5	500	20.9
VIII.....	24, p. m.	51	114	29, a. m.	42	71	2,650	4.5	589	24.5
	27, p. m.	41	118	*1, p. m.	41	70	2,900	4.0	725	30.2
Sums.....							26,975	43.5	7,021	292.5
Mean of 11 paths.....							2,452		638	26.6
Mean of 43.5 days.....									620	23.8

*October.

For graphic presentation of the movements of these highs and lows see Charts I and II.—*Geo. E. Hunt, Chief Clerk Forecast Division.*

CLIMATE AND CROP SERVICE.

By JAMES BERRY, Chief of Climate and Crop Service Division.

The following summaries relating to the general weather and crop conditions during September are furnished by the directors of the respective sections of the Climate and Crop Service of the Weather Bureau:

Alabama.—The month was too wet for maturing cotton, much of the open cotton being damaged by rain; light frosts occurred in northern and north-central counties about middle of the month, doing no damage; rains beneficial to minor crops and for fall seeding.—*Thomas Crawford.*

Arizona.—Conditions were unusually favorable for farming operations and crop development throughout the month. Showery weather that

began during the first week, extended well into the third decade. The water in the irrigating canals was ample for all requirements. The soil was moist and mellow for fall plowing and seeding during the latter part of the month and this work was in active operation. On account of the seasonable weather an increased acreage will be sown in alfalfa and small grain.—*Wm. G. Burns.*

Arkansas.—The drought continued practically unbroken, except by light and widely scattered showers during the first decade. Cotton deteriorated in all sections, being seriously damaged by excessive heat, rust, and bollworms; it opened rapidly and prematurely, but picking was delayed by the hot weather and scarcity of labor. Late corn was

somewhat damaged by drought in northern counties. General and heavy rains fell during the night of the 11th, followed by much cooler weather, with light frost in some northern localities. Picking of cotton became general about the middle of the month, and progressed rapidly, though considerably delayed by rains during the last week, which caused some rotting and sprouting in the bolls. Considerable corn was gathered, the yield being fair to excellent. Picking of apples was commenced, but the yield was generally light. Not much plowing was done, the ground being too dry for this work. Minor crops received much benefit from the rains of the last week.—*F. H. Coleman.*

California.—Conditions were generally quite favorable for late deciduous fruits and grapes and for rasin making and prune drying. High winds in the interior toward the close of the month caused some injury to late fruits. Forest fires destroyed large quantities of timber and other property. Raisins and prunes are yielding heavy crops. Citrus fruits continue in good condition.—*Alexander G. McAdie.*

Colorado.—The first half of the month was very dry, while the latter half was characterized by a large number of rainy days, with exceptionally heavy precipitation throughout the greater part of the area north of Arkansas-Platte Divide. These heavy rains were opportune in many ways. The large number of forest fires in the mountains were extinguished, the threatened water famine was relieved, water holes on the ranges were filled, and the soil put in fine condition for plowing and the seeding of fall grains. The season was too far advanced for any improvement to result in the condition of the ranges. Frost on the 12th was severe in localities east of the mountains; corn and potatoes were injured, but there was no heavy frost in the lower Arkansas Valley until the latter part of the month, which time usually marks the close of the cantaloupe season. Conditions on the western slope were favorable to the marketing of large crops of late fruits.—*F. H. Brandenburg.*

Florida.—Favorable conditions prevailed during the first part of the month, but the frequent and heavy rains during the second part proved to be rather too severe. Everywhere, except the southern portion of the State, the rains were excessive. Oranges split, but not to a serious extent. Corn, cane, sweet potatoes, and strawberry plants were favored by the weather, and at the close of the month great activity was displayed in preparing for the early vegetable season.—*G. Harold Noyes.*

Georgia.—The weather departed considerably from normal conditions and in some respects was very much like that of September, 1901. The temperature was below the normal and the rainfall above. The first and third decades were generally warm. Cool weather prevailed during the second decade, especially from the 13th to 16th, inclusive, when light frosts occurred in the extreme northern sections. The rainfall was copious in portions of the northern section and over the major part of the southern section. It was largely deficient in the east-central counties, where the monthly totals were generally under 2 inches. Drought was broken in many sections, but the rain came too late to benefit cotton. Much of the open staple was damaged, bolls rotted and plants were blown to the ground by high winds. Owing to the forwardness of the season picking was pushed as rapidly as practicable and was mostly completed. The yield was estimated to be largely below normal.—*J. B. Marbury.*

Idaho.—From the 25th to the 28th local snow squalls occurred in mountain districts, and on the 29th there was a remarkable fall of temperature throughout the extreme eastern counties, causing ice to form in many agricultural sections. Owing to the advanced stage of vegetation the damage was slight. All farm work progressed except fall plowing, which has been delayed owing to hard ground, incident to deficient precipitation.—*S. M. Blandford.*

Illinois.—Cool, very wet weather during the month retarded farm work and delayed maturity of corn, but at the end of the month plowing for wheat and rye was well advanced and seeding had begun in all but the extreme northern portion of the State. The frosts of the 12th, 13th, and 14th did considerable damage to corn on low lands in the northern portion, but throughout the remainder of the State the damage was slight.—*Leon J. Gulhrrie.*

Indiana.—Corn ripened slowly, but cutting was in progress in some portion of the State throughout the month and the bulk of that work in the central and southern sections was completed. In the northern section corn cutting, as well as plowing and most other outdoor work, was almost wholly suspended during the last week of the month on account of the frequent and heavy rains. But little injury to corn resulted from the frosts and, at the close of the month, practically the entire crop, which promised a heavy yield, was advanced beyond danger of injury. Fall plowing was well advanced and a considerable acreage of seeding was done. Some early planted wheat was up and looking well. Pastures were good, and stock, with the exception of hogs, was in good condition.—*W. T. Blythe.*

Iowa.—The month was too wet and cold for ripening corn and other immature crops, and the frosts from 11th to 13th caused heavy damage to the corn crop, the injury being greatest in the north half of the State. The percentage of soft corn, having but little value except for immediate feeding, will be much greater than usual, ranging from about 25 per cent in southern section to over 60 per cent in the northern section. In quantity all field crops have been much above the average, but the quality has been much impaired, and a large per cent of cereals practically de-

stroyed. It has been the most unfavorable season for farm work that has been experienced in Iowa since 1869.—*John R. Sage.*

Kansas.—The month was cool; the first week was very wet in the eastern division, with little or no rain in the middle and western divisions; the second and third weeks were dry except in the extreme southeastern counties; the last week was very wet except in the extreme southwestern counties. Wheat and rye sowing began the first week and had become general by the third week. Corn cutting continued in the central and northern counties and husking in the central and southern. Prairie haying was pushed in all parts and a large crop was put up. Much alfalfa seed was sown, but all field work was stopped by the heavy rains of the fourth week. Early sown wheat and rye began coming up the second week and by the end of the month a good stand was had over a large part of the State. Apples were fine and the crop large; picking began the last of the month. Potato digging began the latter part of the month. Some damage was done to corn in the shock by the heavy rains the last week, which also damaged some potatoes in the ground.—*T. B. Jennings.*

Kentucky.—Cool weather prevailed quite generally until the last week, causing delay in the maturing and ripening of all crops. Frosts occurred in many localities from the 13th to 15th. It was not severe enough to injure vegetation to any great extent, but a great deal of corn and tobacco was cut green on account of it. The rainfall was abundant, except in the eastern section, and the droughty conditions there were relieved during the last week. Late fields of corn and tobacco improved considerably; pastures revived and good fall grazing is assured. Wheat sowing progressed fairly well.—*H. B. Hersey.*

Louisiana.—The weather during the month was not very favorable for cotton. Hot, dry weather which prevailed prior to, and at the opening of, the month checked the growth of the plant and caused much shedding. The bulk of the crop was open by the middle of the month. The weather was favorable for picking during the early part of the month, but progress was slow on account of lack of labor. Showers toward the close of the month interfered with picking and injured the crop to some extent. In places seed sprouted and lint rotted in the bolls. The crop is very irregular; the conditions vary materially in the same parish. Sugar cane made good growth and developed rapidly. In places the crop is up to an average, but the bulk of the crop is smaller than usual. Rice harvest and thrashing continued during the month. The yield was not satisfactory.—*I. M. Cline.*

Maryland and Delaware.—Frosts of the 4th to 6th and 14th to 16th hurt late corn and late buckwheat, and killed the gardens in the extreme west, but caused no loss elsewhere. Barring local drought, the moisture supply was sufficient for crops, but the ground was too dry for much advance in plowing until the unusually heavy rains of the 24th to 26th, and after that it was entirely too wet for any progress in that direction. Most of the corn was cut and shocked in good condition, the ears on the early corn being fair to good in quality, but those on the late corn were poorly filled. Buckwheat gave fair to good yields. Tobacco was saved, except for some late fields; the crop was short, but the quality good, although damp and foggy weather after the 24th damaged some half cured tobacco in the barns. Winter apples were light; peach yields were concluded after an unsatisfactory season; pears were plentiful and of good quality; potatoes turned out well; tomatoes were still yielding at the close of the month.—*Oliver L. Fassig.*

Michigan.—September was generally an unfavorable month for the maturity of corn, beans, and potatoes on account of the almost uniformly cool nights and much cloudiness and precipitation during the days. Sugar beets did well throughout the month, although better weather conditions could be desired; at the close of the month beet pulling had commenced and the harvest indicated a good crop, the tonnage being very satisfactory and the percentage of sugar somewhat higher than last year. Buckwheat filled and ripened nicely, and its harvest began about the middle of September; the bulk of the crop was secured in good condition before the heavy rainfall of the 23d. Corn made very unsatisfactory progress toward maturity during the entire month; it continued backward, green, and soft. Considerable corn was cut green for fodder; by the 20th corn cutting had become general, but the heavy rains of the 23d to 30th molded much of that which was in shock; high winds and heavy rains beat down much of the uncut corn. Late potatoes continued to show much blight throughout the month, and the very wet soil rotted many of them, especially on low ground; as a whole the late potato crop is a poor one. The rains germinated early sown wheat and rye very rapidly and made pasturage excellent; the soil at the close of the month was in excellent condition for seeding, although that work has been considerably delayed by the continuous rains.—*C. F. Schneider.*

Minnesota.—The frost on the 13th was very severe in all parts of the State, killing ungathered late potatoes, all the corn, except the very earliest, some of which had been gathered, and very small quantities of barley and flax still remaining uncut. Advantage was taken of the dry portions of the month for continuing thrashing from the shock, and beginning thrashing from the stack. The delay in getting the crops off the fields has delayed plowing. The rot in ungathered potatoes was serious. The usual seeding of small areas of rye and winter wheat has been done. The harvesting of a splendid sugar beet crop was begun late in the month.—*T. S. Outram.*

Mississippi.—The heavy rainfalls and deficiency in mean temperature

of the month were unfavorable to cotton, which deteriorated gradually during the month. The unusually large number of cloudy, rainy days caused much bottom cotton to rot and sprout, and also retarded picking; much open cotton was beaten out of the bolls by the rain and wind and its quality thus lowered. In the eastern and southern portions of the State the crop was very light and, notwithstanding the unfavorable weather, picking was nearly completed in some sections, while in the delta and northern counties the outlook was more promising, and from fair to good yields were being secured. Corn gathering was in progress, the yield generally being much below the average. Sorghum was yielding well. Pea vines made a thrifty growth during the month, but did not bear much fruit. Fall gardens and late sweet potatoes were promising. Pastures were in good condition.—*W. S. Belden.*

Missouri.—The cool, showery weather of the month was unfavorable for ripening corn, but practically the entire crop was well matured by the close of the month. Killing frost on the 13th damaged late corn in localities in the northern and eastern sections, but the loss was comparatively slight. During the last decade of the month, however, there was much complaint that corn in shock was molding and that on the stalk sprouting and rotting, especially where down, as a result of continued rainy and cloudy weather. Where thrashing had not been completed, grain in stack was also greatly damaged by the wet weather. Preparations for fall seeding generally progressed favorably until the 20th, the soil being in good condition, and in some localities wheat sowing was nearly completed, but during the remainder of the month work was practically at a standstill. Early sown wheat came up to good stands and made excellent growth.—*A. E. Hackett.*

Montana.—Favorable weather permitted the completion of the wheat and oat harvest during the first part of the month, and thrashing was brought to a close about the 15th; the yield of grain ranged from an average to very good, and in some places was exceptionally heavy. Hay is all in stack and the crop, as a rule, gave a most satisfactory return. The yield of the second crop of alfalfa was quite good in most sections. The late potato crop was generally unsatisfactory, as a considerable portion of it was ruined by frosts or freezes; all late vegetables were also damaged or ruined in like manner. The apple crop in Flathead County proved unusually good. Ranges are very dry.—*Montrose W. Hayes.*

Nebraska.—The first two weeks in September were dry, there being only a very few light showers in the State. The temperature was low and corn did not mature rapidly. However corn made substantial progress during the first ten days. A heavy, and in most places killing, frost occurred on the 12th and 13th. In the northwestern portion of the State a severe frost occurred on the 9th. Corn leaves and tender vegetation were killed except in spots on highland or in protected places. Late corn in the southern counties and all but the early planted in northern counties was injured by the frost. This will make considerable soft or unmerchantable corn; nevertheless the crop of good corn promises to be large. The frost injured hay and fodder crops. The dry weather the first part of the month was unfavorable for sowing wheat and the heavy rains of the last ten days largely prevented sowing, so that the amount of wheat sown at the end of the month was much less than usual. Early sown wheat is up and growing nicely.—*G. A. Loveland.*

Nevada.—Ideal weather for harvesting operations prevailed throughout the State during the entire month. The temperature conditions were about normal, while the precipitation was much lighter than usual for September in nearly all districts. No frosts until after part of month, giving late products ample time to ripen.—*J. H. Smith.*

New England.—Much cloudiness prevailed during the month, with precipitation decidedly above the average. The temperature ranged somewhat above the normal, and owing to this fact and the overcast skies during a large portion of the time, frosts were of seldom occurrence and not destructive. The weather was favorable to vegetable growth, but unfavorable to harvesting and housing crops.—*J. W. Smith.*

New Jersey.—The heavy rains that fell from 26th to 29th, inclusive, brought all farm work to a standstill. Winter grain and grass, sown before the rain, were greatly benefited, as well as meadows and pastures. The cool weather during the month retarded the ripening of corn, especially in the northern section, where the crop has been greatly shortened.—*Edward W. McGann.*

New Mexico.—Very dry in northern sections, particularly in the northeast, where the dry season has been unusually severe. There is practically no hay secured in the northeastern counties, and as there is a serious scarcity of winter feed on the ranges many stockmen are preparing to move their stock for the winter. Southern ranges are very good.—*R. M. Harding.*

New York.—The month was generally dry until the 23d, and during that time was favorable for maturing and harvesting crops, but it was very rainy after that date, delaying the harvest of corn, beans, buckwheat, and potatoes, and the seeding of wheat and rye, which, however, was well advanced and some was up and making a good start. Corn, beans, and potatoes were very poor, and apples, grapes, and hops were light, but tobacco was saved in good condition. Pastures were good and fall feed plentiful. No generally destructive frosts occurred during the month.—*R. G. Allen.*

North Carolina.—Frequent showers during the first decade of September gave sufficient moisture for growing crops and greatly revived vege-

tation that had suffered from drought during the latter part of August. The last decade of the month was also warm and showery, favored the development of top bolls of cotton, and placed the ground in excellent condition for plowing and for seeding winter wheat. A long period of abnormally low temperatures prevailed from the 9th to the 20th, which was unfavorable for the maturity of late crops. Frosts occurred on the 10th, 11th, 14th and 15th in western districts, with considerable damage to corn and buckwheat. Cotton did not improve any this month, and by the close nearly three-fourths of the crop had been picked out and very little remained to open. Much early corn was gathered and the crop on lowlands was very fine; young corn remained green and ears filled well. Tobacco continued to cure well, considerable amounts remained uncured in the northwest portion. Good crops of hay, peanuts, rice, and sweet potatoes were secured.—*C. F. von Herrmann.*

North Dakota.—Killing frosts from the 12th to 20th destroyed all vegetation that was not matured, consisting mainly of some late wheat, flax, and corn. Fairly heavy rains in some few sections retarded thrashing and damaged grain in shock and stack by causing it to sprout. High winds during most of the month also delayed stacking and thrashing and destroyed considerable hay. In most sections, fall plowing was either done with difficulty or not done at all on account of the ground being too dry.—*B. H. Bronson.*

Ohio.—The month was cool and wet. Killing frost occurred on most lowlands in the north and central sections on the 14th and 15th and damaged corn, potatoes, and vegetables. Late corn ripened slowly; much early corn was injured in shock by the wet weather. Wheat seeding was delayed, but the early sown came up nicely; clover seed damaged by wet weather. Apples are light crop in central and south and only fair in north.—*J. Warren Smith.*

Oklahoma and Indian Territories.—September was remarkable for continued low temperature and heavy precipitation; the average temperature was the lowest on record, while the precipitation was the greatest, with one exception; heavy rains between the 17th and 23d caused much damage to cotton and lowland property; crop growth and farm work were retarded by cool, wet weather; plowing progressed at intervals, and soft wheat was sown and came up well; rye also came up to a good stand; cotton picking progressed slowly and about half of crop was secured, with poor to good yields; corn, broom and kafir corn, cane, peanuts, sweet potatoes, and grass were secured with fair to good yields; pastures are good and stock is doing well.—*C. M. Strong.*

Oregon.—The weather during the month was favorable for the completion of harvesting and thrashing, but too dry for pastures and root crops. Hop picking began during the second week and by the 20th work was practically finished in all but a few yards. The crop was slightly below the average but of a superior quality. Prune drying was in active progress at the close of the month.—*Edward A. Beale.*

Pennsylvania.—Droughty conditions extended into and throughout the first decade of the month, causing late corn to dry up before maturing and a delay in the seeding and germination of fall grain. The rainfall was heavy and continuous after the 20th, particularly in the eastern part of the State, where totals of 8 inches and over were recorded. Frosts were quite general on the 14th and 15th and damaging in some localities to late crops, but in most parts of the State vegetation was green and uninjured at the close of the month. No unusual extremes of temperature occurred. Matured crops were secured in good condition.—*T. F. Townsend.*

Porto Rico.—The rains during the first three weeks were local and farm work and growth of crops irregular, but during the last week the rains were general and abundant, greatly reviving suffering vegetation as well as permitting the active resumption of work in the fields. The planting of cane for gran cultura, already so long delayed, was commenced with vigor. In places the young canes were checked but it is thought they experienced no real harm. Owing to the drought coffee berries matured very slowly and little picking has yet been done; the crop promises a large yield. A considerable quantity of tobacco seed was planted during the month, but the seed beds were more or less damaged by the heavy showers and the overflowing streams in places. The harvesting of the corn and rice crops was completed. Yield of rice cut short by the dry weather. Fruits abundant and excellent. Vegetables and ground provisions generally plentiful. Pasturage good.—*E. C. Thompson.*

South Carolina.—Although the temperature was below normal it was never sufficiently cool to check the growth of fall crops. The precipitation was unevenly distributed, but was beneficial, although slightly damaging to lands in a few places, and the rains interfered with haying and cotton picking to some extent. Late corn ripened and, under the influence of favorable weather, became a promising crop. Early corn was gathered. Cotton opened rapidly and picking made equally rapid progress and was more nearly finished than is usual in September. In some fields there is a luxuriant new growth that bloomed profusely and fruited heavily, but will require an exceptionally late fall to mature. Sea island cotton developed into a fine crop. Rice was largely harvested. Sweet potatoes and other minor crops, gardens and truck, did well and improved throughout the month. The weather was altogether favorable to agricultural interests. Some oats were sown and came up to good stands.—*J. W. Bauer.*

South Dakota.—Dry weather prevailed until the 15th, when the stack-

In the following table are given, for the various sections of the Climate and Crop Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings:

Summary of temperature and precipitation by sections, September, 1902.

Section.	Temperature—in degrees Fahrenheit.								Precipitation—in inches and hundredths.					
	Section average.	Departure from the normal.	Monthly extremes.						Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
Alabama	73.4	-1.6	Daphne	97	1	Newberg	34	13	4.28	+1.18	Riverton	12.41	Helena	0.40
Arizona	75.8	-0.3	Tuskegee		2	Flagstaff	22	29	1.08	-0.06	Yarnell	3.15	Several stations	0.00
Arkansas	68.4	-5.3	Aztec	116	4, 5	Pond	30	13	5.06	+2.02	Pinebluff	9.31	Dardanelle	2.63
California	70.7	+1.6	Malvern	99	8	Witts Springs	14							
Colorado	57.0	-2.0	Volcano	118	6	Bodie	6	26	0.01	-0.38	Crescent City	0.76	Many stations	0.00
Florida	79.4	+0.5	Blaine	105	7	Breckenridge	12	26	1.91	+0.91	Fort Collins	7.12	Lamar	0.00
Georgia	73.0	-1.4	Rockwell	100	1	Molino	53	15	9.44	+2.10	Fernandina	20.25	Key West	3.37
Idaho	56.8	+0.3	Molino		6									
Illinois	82.8	-3.9	Millen	100	4	Clayton	40	14	4.64	+1.10	St. Marys	18.26	Hephzibah	0.55
Indiana	63.8	-3.4	Payette	99	8	Chesterfield	9	29	0.51	-0.42	Murray	2.22	8 stations	T.
Iowa	59.1	-5.2	Flora	94	17	Lanark	29	12	4.14	+0.94	Antioch	7.35	Cisne	1.55
Kansas	63.8	-5.0	Washington	95	3	Winamac	24	14	4.76	+2.00	Fort Wayne	9.87	Mount Vernon	2.46
Kentucky	87.3	-3.1	4 stations	88	2, 7	Galva	23	11	4.35	+1.36	Ottumwa	10.41	Clear Lake	1.65
Louisiana	76.4	-1.2	Viroqua	102	7	Achilles	24	12	3.62	+1.01	Wakeeney	8.57	Viroqua	0.25
Maryland and Delaware	66.1	-1.5	Pikeville	97	2	Marrowbone	29	14	4.01	+1.34	St. John	8.26	Richmond	1.58
Michigan	58.0	-2.2	Minden	102	8	Robeline	40	14	6.24	+2.50	Jennings	10.94	Abbeville	3.36
Minnesota	55.2	-4.0	Chewsville, Md.	101	1	Deerpark, Md.	25	15	6.19	+2.08	Coloma, Md.	12.93	Cumberland, Md.	1.38
Mississippi	73.4	-2.0	Mount Clemens	90	1	Sidnaw	19	14	3.96	+1.36	Hagar	8.22	Potosky	0.23
Missouri	63.2	-5.9	Owosso		4									
Montana	53.1	-1.1	Beardsley	96	7	Beardsley	19	18	2.23	-0.56	Albert Lea	5.37	Beardsley	0.06
Nebraska	59.6	-3.9	Okolona	98	1	Aberdeen	34	13	5.12	+2.06	Fayette	11.26	Okolona	2.57
Nevada	61.1	0.0	Willow Springs	95	7	Ironton, Potosi	30	14	4.77	+1.37	Wheatland	10.92	Hermann	1.81
New England	61.6	+1.3	Crow Agency	92	4	Culbertson	15	17	0.48	-0.55	Bozeman	2.07	Fort Benton	0.00
New Jersey	64.6	-1.7	Glasgow		24									
New Mexico	62.3	-1.7	Callaway, Imperial	100	7	Gering	21	12	3.54	+1.54	Franklin	7.40	Cody	0.08
New York	60.8	+0.4	Rioville	113	6	Quinn River Ranch	10	29	0.21	-0.11	Eureka	1.00	Several stations	0.00
North Carolina	68.9	-1.6	Nashua, N. H.	95	1	Patten and Van Buren, Me.	27	26	4.49	+2.15	Jacksonville, Vt.	7.92	Newport, Vt.	1.14
North Dakota	53.6	-3.8	Indian Mills	93	1	Charlottesville	30	15	5.65	+1.97	Layton	8.95	Lakewood	3.11
Ohio	63.6	-2.0	Carlsbad	101	10	Winsors	20	27	0.96	-0.68	Roswell	3.08	Albert	T.
Oklahoma and Indian Territories	68.2	-5.4	Saratoga Springs	94	1	Axtion	22	5	3.94	+0.47	Southampton	8.94	De Kalb Junction	0.50
Oregon	60.0	+1.0	Selma	98	3	Linnville	27	14	4.56	+0.22	Horse Cove	11.30	Mocksville	2.32
Pennsylvania	62.7	-1.0	Napoleon	95	7	Gallatin	15	12	0.73	-0.24	University	2.08	McKinney, Minot	T.
Porto Rico	79.1	-0.6	Fort Yates		8									
South Carolina	72.1	-2.2	Thurman	94	23	Atwater	24	15	4.55	+1.94	Bowling Green	9.25	Warsaw	2.07
South Dakota	57.8	-4.0	Goodwater, I. T.	104	1	Beaver, Okla.	32	27	5.94	+3.12	Holdenville, I. T.	13.55	Beaver, Okla.	0.00
Tennessee	68.0	-2.1	Grant's Pass	103	9	Bend	12	28	1.01	-0.89	Glenora	4.65	Klamath Falls	0.00
Texas	76.4	-1.3	Huntingdon	99	2	Dushore	28	15	4.66	+1.61	Pocono Lake	11.95	Elwood Junction	1.50
Utah	60.1	-0.7	Hacienda Perla	99	4	Barros	55	16	6.72	-1.14	San Salvador	13.57	Hacienda Amistad	2.28
Virginia	66.4	-2.7	Beaufort	98	2	4 stations	43	*	3.74	-0.11	Beaufort	7.97	Bowman	1.10
Washington	57.3	-0.3	Bowdle	101	7	La Belle	19	12	1.02	-0.31	Yankton	8.17	Pedro, Westington Springs	T.
West Virginia	64.8	-3.4	Springfield	97	8	Rugby	29	14	4.61	+1.57	Franklin	9.26	Dyersburg	1.74
Wisconsin	57.0	-2.4	Fort Ringgold	105	6, 9	Mount Blanc	39	13	5.02	+1.88	Cuero	12.03	Fort McIntosh	0.09
Wyoming	53.6	-2.4	Haskell	8		Amarillo	30							
			St. George	103	3, 6, 7	Woodruff	10	17	0.56	-0.24	Monticello	2.09	Blue Creek, Promontory	0.00
			Bedford City	95	1	Burkes Garden	28	15	3.62	-0.16	Charlottesville	6.46	Stephens City	1.46
			Lind	98	6	Wilbur	20	23	1.64	-0.21	Clearwater	5.17	Trinidad	0.01
			Magnolia	98	2	Travellers' Repose	25	15	2.98	+0.31	Elkins	4.81	Creston	1.23
			Racine	89	1	Prentice	21	13	3.95	+0.21	Racine	6.80	Appleton	1.39
			Basin	95	4	Iron Mountain	12	12	1.18	+0.33	Cheyenne	3.52	Border	0.02
			Thermopolis		7									

* 13, 15, 16.

ing of spring wheat, oats, and barley was completed. The thrashing of these grains, although somewhat retarded in southeastern counties by rains after the 15th, and a little by winds, was by the close of the month over half completed, with generally satisfactory yields, especially of oats and barley. Corn made fairly good progress during the first decade, but the crop was permanently and very seriously damaged by severe frost on the 12th and 13th. At the close of the month the indications were that probably less than half of the crop had escaped material injury, that much would be soft but would likely make fairly good feed, and some was spoiling, with picking of the matured, and cutting of much of the damaged for fodder, becoming general. Plowing was retarded in some northern counties by dry soil, but progressed well in the southeastern counties. Potato digging and haying made very good progress and winter rye sowing was favorably advanced. Flax yields were fair to good. The frost killed most garden stuff and some late potatoes and flax, and injured some late fruit.—*S. W. Glenn.*

Tennessee.—The rainfall was generally ample for growing crops, and during the latter half of the month conditions were very favorable for plowing and for seeding wheat and oats. Early sown oats and rye and second crop of Irish potatoes came up well and made good growth. Tobacco developed well and most of the crop had been cut and some of it cured by the end of the month; considerable injury to this crop resulted from frosts on the 13th and 14th. Cotton opened rather slowly, as a rule, and toward the end of the month picking was delayed by rains, which also considerably damaged the staple in the fields. Late corn improved decidedly during the month.—*H. C. Bate.*

Texas.—There were no notable phenomena recorded within the State during the month. Agriculturally, the event of the month was the breaking of the severe August drought by general rains during the first week in September. These rains were followed later in the month by heavy rains over nearly the entire State, which thoroughly stocked the soil with water and gave ideal conditions for seeding grain and planting fall gardens. Cotton picking was interrupted frequently by rain and during the last decade there was much complaint of open cotton sprouting, molding, and rotting; the bulk of the crop had been picked, however, prior to the September rains, and the portion of the crop adversely affected was comparatively small. Weevil continued to inflict damage to forms and squares and in scattered sections bollworms were numerous. Cotton made a rapid second growth, and in scattered sections gave promise of a fair top crop. Wheat, rye, oats, and barley seeding were accomplished in many sections under favorable conditions, and the early seedings were up to fine stands at the close of the month. The September rains greatly improved pastures and forage crops, and stock generally showed improvement in condition as a result of abundant feed.—*Edward H. Bowie.*

Utah.—The rainfall of the northern and southern sections was generally too light to be of service, and that of the middle section came too late to be of very much benefit to the ranges. The ground was generally too dry for fall plowing and seeding. Killing frost was quite general over the State on the mornings of the 26th and 27th, but crops were too far advanced to be much damaged thereby.—*L. H. Murdoch.*

Virginia.—With the exception of two brief cool periods, the month was

favorable for the growth and maturing of crops in the eastern portion. Drought prevailed in the western portion, seriously affecting late corn, potatoes, and pastures, and retarding fall plowing and seeding. Tobacco was cut and housed under favorable weather conditions.—*R. F. Young.*

Washington.—The month was exceedingly favorable for the harvesting of crops and all were secured in good condition. It was too dry for pastures and late vegetables during the first half of the month. Copious showers on the 18th and 19th and general rains from the 24th to the 27th, inclusive, broke the drought, revived pastures, and put the soil in good condition for fall seeding and plowing.—*G. N. Salisbury.*

West Virginia.—September was rather a cool month, and the dry weather was unfavorable for crops. During the last week fairly good showers fell, which were very beneficial in softening the soil, furnishing a water supply, and freshening pastures; late corn was considerably improved by the warm, showery weather, and will make about a half crop; fall plowing was in full progress and buckwheat was being thrashed with a fairly good yield; cabbages, turnips, and late Irish potatoes will make about half crops, and stock was in fairly good condition.—*E. C. Vose.*

Wisconsin.—The first killing frosts of the season occurred generally throughout the State on the 12th and 13th, except for a few favored local-

ities in the southern counties and a narrow strip bordering on the lake. Corn had generally not reached maturity, and the damage was very great. There will be very little hard corn in the State. The late potatoes were also injured by the frosts. The apple crop made surprising improvement during the months of August and September, and a large crop of excellent quality is being harvested. The cranberry crop was injured to a considerable extent by the frost. Damage to the cultivated marshes where there was sufficient water for flooding was not great, but wild bogs suffered severely.—*W. M. Wilson.*

Wyoming.—The month was a cool one, but much fine, pleasant weather prevailed. The first half was very dry, practically no rain falling, but during the latter half unusually heavy rains fell all over the State and were of much value to the stock interests. Farming operations progressed favorably. Grain cutting and thrashing made good progress during first half of month with yield below average. Native hay and alfalfa all in, with average crop for whole State, but large shortages in sections, inducing some early and heavy shipments of cattle. Stock as a rule in good condition. A general frost on 12th did little damage as most crops were gathered. Ranges revived somewhat and streams flushed as result of heavy rains.—*Charles E. Ashcraft, Jr.*

SPECIAL CONTRIBUTIONS.

THE RAINFALL IN THE CITY OF MADRAS AND THE FREQUENCY OF SUN SPOTS.

By M. B. SUBHA RAO, First Assistant, Observatory, Madras, India.

The high temperatures that prevailed in Madras during 1900 and the scarcity of rain both in 1899 and 1900, made me think that these high temperatures might possibly be connected with the paucity of rain. With the object of investigating the subject, I began to hunt up the records at hand and was led to believe that the period 1899 and 1900 resembled the period 1867-68 in many respects. With the little experience I had in meteorological work, as well as with records at hand to fall back on, I began at the middle of 1900 to write short notes predicting the condition of weather at Madras for a local bi-weekly paper. Emboldened with the success of my prediction I thought of making a thorough investigation of the matter.

Just then the question of the relation of Indian famines and the sun spots was being discussed in the scientific world. I thought then I had better have the list of sun-spot frequency with me before I commenced with the work. Early last October, I applied ultimately to Prof. C. Abbe, of Washington, for a copy of the list, and in December last I was kindly favored by him with one from the year 1749 to 1899.¹ But untoward circumstances prevented me from taking up the work in hand till the end of this April, though I had been collecting the material required since 1900.

Temperature and rain.—Generally years during which high temperatures are recorded are dry years, on some occasions the rainfall being much below the average (49.02 inches). But the years 1870, 1872, 1877, 1880, 1883, 1884, 1887, 1896, and 1898 are found to be exceptions to the rule. During these years the rainfall was very heavy. The years 1870, 1873, and 1874 are rather remarkable ones. The rainfalls for these years are among the highest on record, and occurred in the years of the maximum sun-spot frequency. If the high temperatures are dependent on a low frequency of sun spots, or both of them are caused by something unknown emanating from the sun, these years are a strange exception to the rule. It is curious to note, however, that the heaviness of rain during these exceptional years is caused by the northeast monsoon, which lasts in Madras generally from the middle of October to the middle of December. On the other hand, the years in which

low temperatures are recorded are not exclusively years of heavy rain. During 1864, 1865, 1885, and 1899, though the highest temperatures recorded are much below 105° F., the rainfall is also much below the average.

These apparent exceptions can not be satisfactorily explained. If, perhaps, the whole of the east coast meteorological phenomena are taken into consideration the anomaly might probably disappear, or could, with satisfaction, be explained as due to some local cause or other.

Rain and sun spots.—From Tables 1 and 5 it is very clear that the minimum rain occurs almost exactly on the year of minimum frequency of sun spots, the difference being only a year in a few cases.

TABLE 1.

Period.	Years in the period.	Years of minimum sun spots.	Years of minimum rain.
1811-1823.....	12	1825	1823
1823-1833.....	10	1833	1832
1833-1843.....	10	1843	1842
1843-1856.....	13	1855	1855
1856-1867.....	12	1867	1867
1867-1878.....	11	1878	1876
1878-1889.....	11	1879	1880
1889-1900.....	12	1900	1900

* In 1901 the minimum frequency occurs.

TABLE 2.

Period.	Years in the period.	Years of maximum sun spots.	Years of maximum rain.
1811-1823.....	12	1816	1815
1823-1833.....	10	1830	1827
1833-1843.....	10	1837	1839
1843-1856.....	13	1848	1847
1856-1867.....	12	1860	1859
1867-1878.....	11	1870	1870
1878-1889.....	11	1883-84	1883
1889-1900.....	12	1893	1896

From Tables 2 and 5 it is to be seen that the maximum rainfall also takes place when we have the maximum frequency of sun spots. But in this case the difference is sometimes two to three years during one or two periods. It is, however, probable that this discrepancy can be avoided or be satisfactorily explained by taking the mean precipitation of the whole of the east coast, say from 8° to 20° latitude. The problem is worth trying.

Table 3 gives the mean precipitation, both when the sun-spot curve is in ascendance and descendance.

It is generally observed that the fall of rain is greater during the rise than when the curve is descending.

¹The copy here referred to as communicated to Mr. Subha Rao in December, 1901, was practically the same as that which was printed in the MONTHLY WEATHER REVIEW for November, 1901, pp. 505-506. The thorough and important revision of "Wolf's relative numbers for sun spots," published in the MONTHLY WEATHER REVIEW for April, 1902, and elsewhere by Prof. A. Wolfer, of course replaces all the earlier publications on this subject, but the introduction of these numbers into the present memoir would not materially change the conclusions of its distinguished author.